A Dissertation on

"A COMPARATIVE STUDY OF BUPIVACAINE WITH CLONIDINE AND BUPIVACAINE ALONE IN NERVE LOCATOR ASSISTED BRACHIAL PLEXUS BLOCKADE" (SUPRACLAVICULAR APPROACH)

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CERTIFICATE

This is to certify that the dissertation titled **"A COMPARATIVE STUDY OF BUPIVACAINE WITH CLONIDINE AND BUPIVACAINE ALONE IN NERVE LOCATOR ASSISTED BRACHIAL PLEXUS BLOCKADE (SUPRACLAVICULAR APPROACH)"** presented herein by **Dr. R.VASANTHAGEETHAN** is an original work done in the Department of Anaesthesiology, Government Stanley Medical College Hospital, Chennai for the award of the degree of M.D. (Branch X) Anaesthesiology under my guidance and supervision during the academic period of 2004 – 2007.

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DECLARATION

I, **Dr. R.VASANTHAGEETHAN** solemnly declare that the dissertation titled **"A COMPARATIVE STUDY OF BUPIVACAINE WITH CLONIDINE AND BUPIVACAINE ALONE IN NERVE LOCATOR ASSISTED BRACHIAL PLEXUS BLOCKADE (SUPRACLAVICULAR APPROACH) "** is a bonafide work done by me in the Department of Anaesthesiology, Government Stanley Medical College and Hospital, Chennai - 1. under the able guidance of **PROF.R.MEENAKSHI.M.D.,D.A.,** Professor & HOD, Department of Anaesthesiology, Government Stanley Medical College and Hospital, Chennai – 600001.

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PROFORMA

MASTER CHARTS

VAS - Scale

INTRODUCTION

Ever since Koller's original work, the popularity of local anaesthetic has waxed & waned, like that of many other medical developments. There were many positive influences after Lofgren synthesized lignocaine in 1943. Bupivacaine is particularly important, since its long duration of action avoids repeated injection with relatively little risk of cumulative toxicity.

Today regional anaesthesia is well established as equal to general anaesthesia in effectiveness & patient acceptability.

Regional anaesthesia is the blocking of peripheral nerve conduction in a reversible way by using local anaesthetic agents thereby one region of the body is made insensitive to pain and is devoid of reflex response to surgical stimuli. In this the CNS is spared, so that the patient is conscious, fully awake during the surgical procedure without recognizing pain.

For surgeries on upper extremities particularly in emergency surgeries regional anaesthesia has many advantages over general anaesthesia.

The frequent use of pneumatic tourniquet[33] to provide a bloodless field during surgery makes individual nerve blocks impractical. Brachial plexus block[28] is the answer in such a situation. There are different approaches but the ones frequently employed for blocking the brachial plexus[29] include

a) Supraclavicular approach

b) Infraclavicular approach

c) Axillary approach

d) Interscalene approach

Axillary approach[30] has the lowest incidence of serious complications and can be performed with ease. But there are limitations associated with axillary approach[31,32] like

- It is inadequate for operations on the arm and shoulder.
- It is difficult to block the musculocutaneous nerve predictably with resultant sparing of the radial aspect of forearm and dorsum of hand.
- Tourniquet pain is not well tolerated.
- Also abducting the arm by 90 degrees for giving the block may be painful and even dangerous in traumatic lesions of the upper extremity.

The brachial plexus is approached at the level of trunks and the compact arrangement of trunks at supraclavicular level gives a high success rate with minimum local anaesthetic drug volume and a dense & fast onset of block. Hence the supraclavicular approach is the method of choice for blocking the brachial plexus.[29]

.

William Steward Halsted first performed brachial plexus block in 1885. In 1911, Kulenkampff and Hirshel described the first percutaneous brachial plexus block by supraclavicular and axillary routes respectively.

Since then several techniques of brachial plexus block have been described with the purpose of improving the efficacy and success rate and minimizing the risk and rate of complications. Of the various techniques[29] the most widely practiced methods are the classical technique described by Patrick (1940), Vertical plumb bob approach described by Brown, 1st rib walk over technique described by Bonica and Moore and the Subclavian perivascular

technique described by Winnie and Collins (1964).

Of the several local anaesthetic drugs used for brachial plexus block, bupivacaine is used most frequently in our set up as it has a long duration of action varying from 3 – 8 hours[30,33,34].

To prolong the duration of analgesia various drugs have been studied as adjuvant to the local anaesthetic solution and techniques like the continuous catheter placement in the plexus have evolved. These adjuvant drugs ideally are expected to prolong the analgesic effect without causing any systemic side effects or prolonging motor blockade.

Nerve locators are now widely seen as useful aids in nerve blocks. Its use avoids paraesthesia, decreases the chance of nerve injury and gives high success rate.

Clonidine is an α2 agonist has an anti-nociceptive effect on a wide dynamic range of neurons and receptors. In animal studies, Clonidine depressed impulse conduction in isolated nerve fibre with some preference for C-fibres. Used as the sole analgesic, it produced analgesia after intrathecal, epidural and intra articular administration. Clonidine can be safely administered along the neuroaxis and is being used as an adjunct to local anaesthetics to increase the duration of analgesia. It produces analgesia by interacting with α2- adrenergic receptors. These receptors are located on superficial laminae of spinal cord and brain stem nuclei implicated in pain. So analgesia may be produced at peripheral, spinal and brain steam sites.

This study is intended to determine the effects of adding Clonidine to Bupivacaine in brachial plexus blockade by Nerve locator assisted supraclavicular approach, with regard to the onset, intensity and duration of blockade along with its analgesic efficacy.

AIM OF THE STUDY

The aim of the present study is to evaluate the effect of addition of 100µg of Clonidine to 0.375% Bupivacaine solution in Supraclavicular brachial plexus block with regard to following parameters.

- Onset of blockade
- Duration of blockade
- Intensity of blockade
- Sedation
- Quality of analgesia
- Haemodynamic changes &
- Complications if any

ANATOMY OF BRACHIAL PLEXUS [35-39]

Knowledge of the formation of the brachial plexus and of its distribution is absolutely essential for the precise and effective use of brachial plexus analgesia for surgeries of the upper limb. A thorough understanding of the vascular, muscular and fascial relationships of the plexus throughout its formation and distribution is equally essential in order to master the various techniques of brachial plexus analgesia.

In its course from the intervertebral foramina to the arm, the fibres that constitute the plexus are composed consecutively of roots, trunks, divisions, cords and terminal branches, which are formed through a complex process of combining, dividing, recombining and finally redividing.

The brachial plexus is formed by the union of the anterior primary rami of the fifth to eighth cervical nerves and first thoracic nerve with occasional contributions from the fourth cervical nerve (prefixed) above and second thoracic nerve (postfixed) below. These nerves unite to form trunks, which lie in the neck above the clavicle. Its roots pass between the scalenus anterior and the scalenus medius which is enclosed by fascia accompanied by the

subclavian artery and then invaginates the scalene fascia to form a neurovascular bundle. This fascia becomes the axillary sheath in the axilla.

Relations of Brachial Plexus

Anterior relations

The skin, superficial fascia, platysma, and supraclavicular branches of the superficial cervical plexus, the deep fascia and external jugular vein. The clavicle is in front of the lower part and scalenus anterior is in front of the upper part.

Posterior relations

Scalenus medius and the long thoracic nerve of Bell.

Inferior relations

Related to the first rib.

Superior relations

Lies first above and then lateral to the subclavian artery.

Sympathetic contribution to the plexus

Close to their emergence, the 5^{th} and 6^{th} cervical nerves, each receive a grey ramus from the middle cervical sympathetic ganglion. The 7^{th} and 8^{th} cervical nerves each receive a grey ramus from the inferior cervical ganglion.

Roots

Anterior primary rami of C5,C6,C7, C8 and T1 (occasionally C4 or T2).

Trunks

- Upper trunk – anterior rami of C5 and C6
- Middle trunk – anterior ramus of C7
- Lower trunk – anterior ramus of C8 and T1.

Divisions

Behind the clavicle each trunk divides into anterior and posterior divisions.

Cords

- Lateral cord – Anterior divisions of upper and middle trunks (C5 – C7)
- Medial cord - Anterior division of lower trunk (C8 – T1)
- Posterior cord – Posterior divisions of all the three trunks (C5 – T1)

Branches

From Roots

- Nerve to serratus anterior C5,C6, C7
- Muscular branches to longus cervices C5,C6,C7,C8.
- Nerve to the three scalene C5,C6,C7,C8.
- Nerve to Rhomboids C5
- A twig to phrenic nerve C5.

From Trunks

- Suprascapular nerve C5 , C6
- Nerve to subclavius C5 , C6

From Cords

- Lateral cord (three):

  Lateral pectoral C5,C6,C7

  Lateral root of the Median C5,C6,C7

  Musculocutaneous C5,C6,C7

- Medial cord (five):

  Medial root of median nerve C8, T1

  Medial pectoral C8, T1

  Medial cutaneous N of forearm C8, T1

  Medial cutaneous N of arm C8, T1

  Ulnar C8, T1

- Posterior cord

  Radial C5 – T1

  Axillary C5 – C8

  Thorocodorsal C6 – C8

  Upper and lower subscapular C5 – C6

Familiarity with the perineural structures that surround and accompany the brachial plexus as it leaves the vertebral column on its course to the upper arm is as important as the knowledge of the formation and distribution of the neural plexus itself. Palpable muscular and vascular landmarks allow accurate location of the plexus percutaneously. An appreciation of

the fascial relations is absolutely essential since this is the basis for all the perivascular techniques.

After leaving the intervertebral foramina, the anterior primary rami of the nerves destined to become the brachial plexus travel in the gutter formed by the anterior and posterior tubercles of the corresponding transverse processes of the cervical vertebrae. After leaving the transverse process, the roots of the plexus descend in front of the middle scalene muscle, which arises from the posterior tubercles of the transverse processes of the lower six cervical vertebrae. The insertion of this muscle on the first rib is separated from that of the anterior scalene muscle by the inferior trunk of the brachial plexus. The anterior scalene muscle arises from the anterior tubercles of the transverse process of the 3^{rd} – 6^{th} cervical vertebrae and inserts on the scalene tubercle of the first rib, thus separating the subclavian artery from the subclavian vein.

The fascia covering both the scalene muscles is derived from the prevertebral fascia, which splits to invest these muscles and then fuses again at their lateral margins to form an enclosed interscalene space. Therefore, as the roots leave the transverse processes, they emerge between two walls of the fascia

covering the anterior and middle scalene muscles. In their descent towards the first rib to form the trunks of the plexus, the roots may be considered to be sandwiched between the anterior and middle scalene muscles, the fascia of which serves as a sheath of the plexus. As the trunks approach the first rib, they are arranged (as their designations – superior, middle and inferior imply) one above the other vertically, not one next to the other horizontally as depicted in so

many texts.

As the trunks of the plexus cross the first rib, they are joined by the subclavian artery, which lies in a plane anterior to the trunks, so that the inferior trunk lies behind the artery in the subclavian groove with the middle and superior trunks above the level of the vessel. At this level the artery and trunks are moving laterally, across the ribs and invaginate the scalene fascia to form the subclavian perivascular space, which is continuous medially and superiorly with the interscalene space and inferiorly and laterally with the axillary perivascular space.

The important concept is that there is a continuous fascial enclosed perineural and perivascular space extending from the cervical transverse processes to several centimeters beyond the axilla; this space has been divided into an axillary perivascular space and an interscalene space. The existence of such a continuous perineural space renders brachial plexus block simple. The space described may be entered at any level, and the volume of the anaesthetic injected at that level would determine the extent of anaesthesia. Thus, the technique to be used in any case should be determined on the basis of the surgical site, the required level of anaesthesia, the physical status and habitus of the patient.

The upper medial aspect of the arm is not anaesthetized by any brachial plexus block technique, since this area is innervated by the intercostobrachial nerve T2. This nerve can be blocked by subcutaneous infiltration across the upper medial aspect of arm using 3-5ml of local anaesthetic solution for surgical anaesthesia or tourniquet.

The brachial plexus can be blocked at the level of the roots, trunks, cords or peripheral branches. The block at each level has a distinct distribution of anaesthesia, advantages, disadvantages, and complications.

CLINICAL PHARMACOLOGY [42,43,44]

This chapter concerns with the brief review of the clinical pharmacology of drugs used in this study.

BUPIVACAINE HYDROCHLORIDE

It is an amide local anaesthetic synthesized by B.O. Af. Evenstam in 1957 of AB Bofor in Sweden.

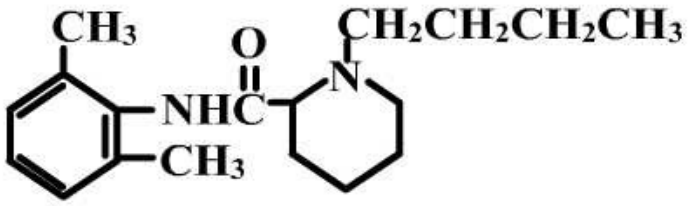
First came into clinical use in 1963 by Widman & Teliuvo.

Chemisry:

An amino amide local anaesthetic having aromatic moiety (benzene ring), which offers lipophilicity to one end of the molecule. It is linked by an amide to a tertiary amine, which is hydrophilic on the other end of the molecule.

IUPAC Name: 1-butyl-N-(2,6-dimethylphenyl)piperidine-2-carboxamide

$C_{18}H_{28}N_2O$



It displays stereoisomerism. Marketed as a racemic mixture containing optically active enantiomers R and S. S–enantiomers have been noted to have slightly longer duration of action and lower systemic toxicity when compared to R-type.

Presentation :

As a clear solution of 0.25/0.5% bupivacaine hydrochloride. The hyperbaric solution contains 80mg/ml of glucose.

Physico chemical properties :

Molecular Weight	:	288
pKa (25^{o}C)	:	8.2
Protein Binding	:	96%
Lipid Solubility	:	28

% Non ionized form at pH 7.4 – 17

pH 7.2 – 11

Mechanism of action :

Local anaesthetics such as bupivacaine block the generation and the conduction of nerve impulses, presumably by increasing the threshold for electrical excitation in the nerve, by slowing the propagation of the nerve impulse, and by reducing the rate of rise of the action potential. In general, the progression of anaesthesia is related to the diameter, myelination and conduction velocity of affected nerve fibers. Clinically, The order of loss of nerve function[44] is as follows: (1) Autonomic, (2) temperature, (3) pain, (4) proprioception, and (5) motor. In a mixed nerve it depends on the histological arrangement of the nerve fibre. The *analgesic* effects of Bupivacaine are thought to be due to its binding to the prostaglandin E2 receptors,

subtype EP1 (PGE2EP1), which inhibits the production of prostaglandins, thereby reducing fever, inflammation, and hyperalgesia.

Pharmacokinetics:

The absorption of local anaesthetics is related to

- The site of injection (Intercostals > Epidural > brachial plexus > subcutaneous)
- The dose : a linear relationship exists between the total dose and the peak blood concentration achieved.
- The presence of vasoconstrictors which delay absorption.

The addition of adrenaline to bupivacaine does not influence the rate of systemic absorption as

- The drug is highly lipid soluble and therefore uptake into fat is rapid.
- The drug has a direct vasoconstrictory effect.

Routes of administration / Doses:

Bupivacaine may be administered topically by infiltration, intrathecally or epidurally. The therapeutic dose of bupivacaine is 2-3 mg / kg (with or without adrenaline).

The drug acts within 10 to 20 minutes and has an average duration of action of 5-6

hours.

Concentration Used :

Infiltration	–	0.25%
Peripheral nerve block	-	0.25 - 0.5%
Epidural Anaesthesia	-	0.25% - 0.5%
Spinal Anaesthesia	-	0.5% Heavy
Epidural Analgesia	-	0.0625% - 0.25%

Pharmacokinetics :

The possible pathways for metabolism of bupivacaine include aromatic hydroxylation, N-dealkylation, amide hydrolysis and conjugation. Only the N- dealkylated metabolite N-desbutyl Bupivacaine has been measured in the blood or urine.

Alpha 1 acid glycoprotein is the most important protein binding site of Bupivacaine. 5% of the dose is excreted in the urine as pipcolloxylidine. 16% is excreted unchanged. Clearance is 0.47 l/min and the elimination half life is about 210 minutes.

Systemic toxicity :

Cardiovasular system

Bupivacaine is markedly cardiotoxic. It binds specifically to the myocardial proteins. In toxic concentrations the drug decreases the peripheral vascular resistance and myocardial contractility producing hypotension and possible cardiovascular collapse. Cardiotoxic plasma concentration of bupivacaine is 8-10 μg/ml.

Central nervous system :

The principal effect of bupivacaine is reversible neural blockade. This leads to a characteristically biphasic effect in the central nervous system. During accidental over dosage or direct vascular injections the clinical signs are numbness of tongue, lightheadedness, visual and auditory disturbances, muscular twitching and tremors. The signs may progress to generalized convulsion of the tonic clonic nature. When plasma levels continue to rise, CNS excitation is rapidly superseded by depression.(drowsiness, disorientation and coma)

The typical plasma concentration of bupivacaine associated with seizure is 4.5 to 5.5 μg / ml.

Allergic reactions :

Allergic reactions to the amide type local anaesthetics are extremely rare._

CLONIDINE HYDROCHLORIDE

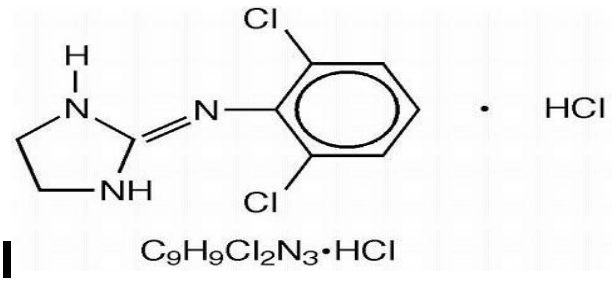
Clonidine an α 2 agonist synthesized in 1960 was originally developed for intranasal administration as a nasal decongestant. Due to its systemic effects (sedation & hypotension) its use as a decongestant has been abandoned.

Chemistry :

Clonidine is an imidazole compound. Molecular weight : 266.56

IUPAC Name : N-(2,6-dichlorophenyl)-4,5-dihydro-1H-imidazol-2-amine

Structure:



$C_9H_9Cl_2N_3 \cdot HCl$

Presentation:

Oral form - 100, 150 µg tablets , Injection 150 µg/ml - clear colourless solution as Clonidine hydrochloride.

Pharmocokinetics :

- Oral bioavailability - 100%
- Plasma protein binding - 30-40%
- Peak Plasma concentration - Reached in 60-90 minutes
- Maximal hypotensive effects - 1-3 hours after an oral dose
- Elimination half life - 6 – 24 hours.

Approximately 50% of the drug is metabolized in the liver to inactive metabolite – P.hydroxyl-clonidine, while the rest is excreted unchanged by the kidney. Approximately 20% of the total amount is excreted with the faeces.

Mechanism of action :

- Activation of α2 receptors in lower brain stem ; these are noradrenergic imidazoline preferring binding sites but they do not bind catecholamines.
- Decreases discharge in sympathetic preganglionic fibres in sphlanchnic nerves as well as in postganglionic fibres of cardiac nerves.
- Stimulates parasympathetic outflow.
- Suppression of release of noradrenaline from peripheral nerve endings.

➢Decreases plasma concentration of noradrenaline and reduces its excretion in urine.

Systemic effects of Clonidine

System	*Site of Action*	*Effects*
Cardiovascular	Brainstem; Spinal cord Peripheral vasculature Heart	Decreased BP. HR Increased BP. SVR Slowed conduction
Central Nervous System	Locus coeruleus	Sedation, anaesthesia
Pain transmission	Peripheral nerve endings Brainstem	Reduced sensitivity Analgesia
Respiration	Brainstem	Reduced respiratory drive
Endocraine	Hypothalamus, Pituitary	Decreased ACTH, LH
		FSH, AVP, Increased GH
	Pancreatic islets	Decreased Insulin
	Spinal cord , periphery	Decreased Catecholamines

➢Clonidine prevents adrenaline induced arrhythmias during halothane anaesthesia.

➢It decreases cerebral blood flow, protecting the brain from abrupt increase in intracranial tension.

➢Clonidine causes hyposalivation, prevents intestinal ion and water secretion in the large bowel.

➢It induces diuresis

➢It induces platelet aggregation.

Clinical Uses :

**** Premedication***

As a premedicant 90-120 minutes prior to induction, produces good sedation, maintains cardiovascular stability intraoperatively without respiratory depression.

It decreases intraocular pressure both before and during surgery.

**** Intraoperative and Postoperative uses :***

Intrathecal clonidine (150μg) as adjuvant with local anaesthetics prolongs spinal anaesthesia.

Clonidine in extradural route is used

- to produce postop analgesia
- for the relief of neuropathic pain and as a therapeautic adjunct in the management of refractory reflex sympathetic dystrophy.
- For cancer pain management

Clonidine may diminish myocardial ischemia intra and post operatively after a single dose providing an important indication in high risk patient.

Clonidine as adjuvant to local anaesthetics prolongs anaesthesia & analgesia in peripheral nerve blocks.

Considerations for use of clonidine in Anaesthesia:

Advantages :-

- Preservation of haemodynamic stability.(Prevent wide swings in HR& BP).
- Induced hypotension.
- Limits the use of potentially toxic anaesthetic / adjuvant agents.
- Preservation of renal function in presence of insult.
- Limits the increase in ICP/IOP.
- Decrease of narcotic induced muscle rigidity.
- Bronchodilation

Disadvantages :

- Transient Hypertension. (Parenteral bolus administration)

I.V. infusion causes acute rise in B.P. because of activation of post Synaptic α2 receptors in vascular smooth muscle followed by a more prolonged hypotension due to decreased central outflow of impulses in the sympathetic nervous system.

- Hypotension
- Bradycardia
- Sedation
- Dry mouth

Reversal :

Clinical effects of Clonidine can be reversed by Atipamezole

PHARMACOKINETICS OF LOCAL ANAESTHETICS IN BRACHIAL PLEXUS BLOCKADE[40]

When a local anaesthetic is injected around a nerve trunk, it will soak the trunk in an advancing front. Transmission in fibers situated in the periphery of the trunk (mantle fibres) will be first blocked and those in the centre of the trunk (core fibres) last. Further, transmission in peripherally placed fibres will be blocked over a longer length of time compared to central fibres. Thus analgesia will appear first and last longest in the territory supplied by the peripheral fibres. If the pool of local anesthetics is small or if the injection was not accurate or too dilute, the fibres in the centre of the trunk will escape blockade.

Theory of Winnie

The trunks are arranged so that the central fibres are the longest supplying the extremities of the limb while shorter fibres are arranged more peripherally as their area of supply is more proximal. Winnie groups the fibres into two: the peripheral mantle fibres which contain the motor fibres and core fibres which are

mainly inner sensory. Peripheral motor fibres supply the muscles of the forearm and the central fibres carry sensation from the hand.

Thus the onset of block in the limb is as follows:

- Loss of motor power to the shoulder and upper arm
- Loss of sensation on the upper arm
- Loss of motor power of the forearm

- Loss of sensation to the hand.

  So the spread of block is from proximal to distal.

BASICS OF NERVE LOCATOR[45,46]

Perivascular technique and elicitation of paraethesia had been the classical methods for locating nerves in peripheral nerve blocks. Peripheral nerve locator technology is a newer one, utilizing objective end points for effective nerve localization.

Peripheral nerve locator is used to elicit Evoked Motor Response(EMR). They are used to assess functioning of Neuromuscular(NM) junction. The names Peripheral nerve locator(PNL), and Peripheral nerve stimulator(PNS) mean the same. When high intensity current is used to assess NM junction function through cutaneous electrodes it is called as PNS. When low intensity current is used to locate the nerve it is called peripheral nerve locator.

History :

Perthes in 1912 and Pearson in1955 demonstrated that a peripheral nerve could be identified by electro stimulation[21,22,23], but it was the work of Greenblatt and Denson[24] in 1962 that introduced the nerve stimulator into anaesthesiology clinical practice. With a resurgence of interest in regional anaethesia and demand for more accurate nerve localization before injection of local anaesthetics, the field of peripheral nerve locators has grown into a larger extent.

Physiological Basis of PNL Technology :

The ability of a nerve locator to evoke a motor response depends on

i) intensity of current

ii) duration of current

iii) polarity of stimulating current used &

iv) needle nerve distance .

Assuming a square pulse of the current is used to stimulate the nerve the total charge applied is the product of intensity of current and duration of the pulse.

Reobase and Chronaxie :

Reobase is the minimal current required to stimulate the nerve with a long pulse width.

Chronaxie is the duration of the stimulus required to stimulate at twice the reobase.

$$I = Ir (1+c/t)$$

Where I - current required, C - Chronaxie,

Ir - reobase, t - duration of stimulus.

Chronaxie is useful when comparing different nerves or nerve fibre types. The larger fibres are more readily stimulated than the smaller fibres. It is possible to stimulate the larger Aα motor fibre without stimulating the smaller Aδ or C -fibres responsible for pain.

Chronaxies of Peripheral Nerves

* A-α → 50 -100 μ Seconds

* A-δ → 170 μ Seconds

* C-Fibres → 400 μ Seconds

Principles of Peripheral nerve stimulation :

i) Preferential cathodal stimulation:

Significantly less current is needed to obtain a response to nerve stimulation when cathode is adjacent to the nerve, rather than the anode.

ii) Variation of stimulus intensity with varying needle nerve distance.

Stimulation intensity will be variable as determined by coulomb's law. A very high stimulus current is required to stimulate the nerve when the needle tip is far away from the nerve.

Components of peripheral nerve locators :

- Oscillator
- Display
- Constant current generator
- Controls.

Characteristics of an ideal PNL

1) Constant current output:-

The constant current designs of the locator allows for an automatic compensation for changes in tissue or connection impedance during nerve stimulation assuring accurate delivery

of the specified current.

2) Options for different pulse width:-

Shorter pulse width corresponds to the chronaxie of motor fibres in a mixed peripheral nerve. Wider pulse width (>100μ sec) is useful for stimulating a sensory nerve or a nerve with compromised conduction i.e. Diabetic neuropathy.

3) A wide range of current output - 0.01 to 5.0 mA :-

A higher current output is needed for patients with neuropathy and sensory nerve stimulation.

4) Digital display of the delivered current.

5) Variable current output dial.

6) Clearly identifiable polarity

7) Disconnect indicator

- Shows circuit connection status

8) Battery indicator

9) Stimulating frequency:-

If the stimulating frequency is higher, it allows faster manipulation of the needle.

Clinical points to be noted while using PNL:

An effective use of PNL technology mandates knowledge of anatomy with respect to

a) Optimal needle insertion site to achieve needle tip – target nerve contact.

b) Muscle innervation scheme of the targeted nerve to identify desired evoked motor response(EMR).

c) Ability to differentiate desired EMR from the alternate EMR elicited by the stimulation of adjacent muscle and collateral nerves.

d) The relationships of adjacent neuromuscular structures generating those alternate EMR to the targeted nerve.

e) The highest rate of success is attained when a brisk EMR occur between 0.2-0.4mA. An EMR at currents higher than 0.5mA may result in failed block because the needle tip is too far from the nerve. A brisk EMR at stimulating current lower than 0.1mA may risk nerve damage because of the possibility of an intraneural injection.

Peripheral Nerve Locator Settings :

1) **Mixed nerve (most PNB)**

Current → 1 mA

Current duration(Pulse with) → 0.1ms

Frequency →1-2 HZ

2) **Sensory nerve** (eg. Lateral cutaneous and saphenous nerve)

Current → 2-5 mA

Current duration → 1ms

Frequency → 1 Hz

3) **Diabetic neuropathy (PNB)**

Current → 2 mA

Current duration → 0.3 ms

Frequency → 1-2 Hz

APPROPRIATE EVOKED MOTOR RESPONSE FOR EACH PNB

PNB Technique	Optimal EMR
Interscalene	Flexor – Deltoid, Biceps, Pectoralis major. Extensor – Triceps, Brachioradialis, Wrist Extensors. (EMR of $\geq$ 2 muscles)
Deep Cervical Plexus	Rhomboids, Shoulder girdle.
Infraclavicular	Muscles of wrist and hand. Radial – Extension of wrist / fingers. Median – Flexion of wrist / fingers. Ulnar – Adduction of thumb/4^{th} & 5^{th} finger flexion.
Femoral	Quadriceps – Patellar snap
Sciatic	Inversion, Plantar flexion

REVIEW OF LITERATURE

* In 1980 **winnie & collins**[1,2] described the subclavian perivascular technique.

Nerve locator :

* In 1985 **smith DC et al**[8] described an inexpensive, portable nerve stimulator which is used to enhance the ease and effectiveness of peripheral nerve blockade.

* **Zaharai DT et al**[9] described the use of a nerve stimulator which allows accurate nerve blocks without causing paraesthesiae and decreasing the possibility of nerve injury.

* **Bashein G et al**[10] **and Ford DJ et al**[12] in their independent studies concluded that, in nerve stimulator assisted nerve blocks, insulated needles more precisely located the peripheral nerves than uninsulated needles.

* In 1980 **Yasuda I et al**[11] described the use of nerve stimulator with insulated needle in supraclavicular brachial plexus block. They identified the plexus at a mean depth of 27mm below the skin and the block was successful in 98% of patients when the stimulation was felt in the index, middle or ring finger.

Clonidine in Spinal Block:

* **Racle JP et al**[4] conducted a study to compare the effects of Clonidine, epinephrine on duration of bupivacaine spinal anaesthesia in 60 orthopaedic hip surgeries. They concluded that significant prolongation of motor block was associated with addition of 0.15 mg of Clonidine with 15mg of bupivacaine.

* **Acalovischi et al**[5] studied the effects of intrathecally administered a adrenaline, clonidine on the duration and quality of Meperidine spinal block in 45 orthopedic surgeries. They concluded that co-administration of epinephrine or clonidine with meperidine enhances the duration and degree of spinal anaesthesia and that adding clonidine prolongs the duration of postoperative analgesia.

Clonidine in Epidural Block :

* In 1994 **Lee JJ et al**[6] have assessed the clinical value of combning 2 μg /kg of clonidine with 0.25% Bupivacaine 1 ml /kg for caudal analgesia in 46 children aged 1-10 years undergoing elective orthopaedic surgery. They observed longer duration of sedation in clonidine group partly from the longer duration of analgesia provided by clonidine and partly from the sedative effect of clonidine. They concluded that when added to Bupivacaine, clonidine improves the efficacy of caudal analgesia in children.

* **Dr.Lt.Col.Upadhyay K.K et al**[7] demonstrated that the addition of chonidine in the doses of 1μg/kg to 0.75 ml/kg of 0.25% bupivacaine for caudal blockade significantly prolongs the duration of analgesia without any additional risk for use in paediatric patients.

Clonidine in peripheral nerve blocks :

* **Eledjam et al**[13] evaluated the effects of clonidine hydrochroride 150 µg, epinephrine 200 µg, with 40-50ml of 0.25% bupivacaine, injected into brachial plexus sheath using the supraclavicular technique in 60 patients who underwent upper limb surgeries. They concluded that the injection of clonidine into brachial plexus sheath is an attractive alternative to epinephrine to prolong the duration of analgesia following upper limb surgery.

* In 2004 **Hutschala D et al**[14] conducted a study to determine whether Clonidine added to Bupivacaine enhances and prolongs the analgesia after brachial plexus block via a local mechanism. They concluded that admixture of clonidine to bupivacaine plus epinephrine prolongs and enhances brachial plexus blockade.. Lower plasma concentration of clonidine for block treatment strongly suggests a local effect.

* **El saied et al**[15] conducted a study to evaluate the effect of adding Clonidine 150 µg to 40 ml of 0.75% Ropivacaine for axillary brachial plexus blockade, on the onset and duration of sensory , motor block and duration of analgesia in 50 patients. They concluded that addition of 150 µg of clonidine to ropivacaine for brachial plexus blockade, prolongs motor and sensory block and analgesia, without an increased incidence of side effects.

* **Singelyn FJ et al**[16] conducted a study to evaluate the effect of 150 µg clonidine added to 40 ml of 1% mepivacaine on the duration of anaesthesia and analgesia after axillary blachial plexus block in 30 patients scheduled for elective hand surgery. They concluded that 150 µg clonidine added to mepivacaine for brachial plexus block prolongs the duration of anaesthesia

& analgesia and this effect of clonidine is local rather than systemic.

Dose range:

* In 1997 **Bernard et al**[41] studied about the dose-range effects of Clonidine added to local anaesthetics for Brachial Plexus Block. They concluded that small dose of clonidine enhances the quality of the peripheral blocks from local anesthetics and limits the alpha$_2$ -agonist side effects to the sedation. The best dose to use clinically is between 30 μg and 90 μg.

Mechanism of Action

* **DM Gumann et al**[19] examined local anaesthetic effects of clonidine and its interaction with lidocaine with regard to tonic inhibition of the C-fiber action potential on the isolated, desheathed rabbit vagus nerve by the sucrose gap method. They concluded that clonidine enhances the effects of lidocaine on C-Fiber action potential.

* **Kroin JS et al**[17] evaluated the mechanism by which clonidine potentiates local anaesthetic action in male Sprague – Dawley rats. Their study findings indicated that prolongation of duration of in vivo lidocaine nerve blockade by clonidine is not mediated by an α-adrenergic mechanism, but likely involves the hyperpolarization activated cation current (Ih).

* **Nakamura et al**[20] Concluded that clonidine in addition to its central analgesic action, can induce peripheral antinociception by an α2 adrenoceptor mediated local release of enkephalin like substances.

* **Kopacz et al**[18] conducted a study to evaluate the effect of Clonidine on lignocaine clearance in vivo with microdialysis probes. They found that clonidine prolongs local anesthetic block party by a pharmacokinetic mechanism.

MATERIALS AND METHODOLOGY

Forty adult patients of both sexes in the age group of 20-60 years belonging to ASA I/II category and their weight ranging between 50-70 kgs posted for various types of upper limb surgeries at the Department of plastic surgery, Institute of Research and rehabilitation of Hand, Government Stanley Hospital, formed the study group.

This study was designed as a prospective randomized comparative study. After receiving the institutional ethical committee approval and informed consent, the patients were randomly allocated into two groups. Supraclavicular brachial plexus block was performed via peripheral nerve locator assisted subclavian perivascular technique.

Groups:

1. **Group – B** (**B**upivacaine alone) – 20 patients received 30 ml of 0.375% Bupivacaine with 2 ml of 0.9% sodium chloride solution.

2. **Group – BC** (**B**upivacaine + **C**lonidine) – 20 patients received 30 ml of 0.375% Bupivacaine with Clonidine hydrochloride 100 µg (1 ml of 150µg diluted with 2ml 0.9% Nacl solution. From that 2ml used for study.).

Inclusion Criteria:

- ASA PS I & II

- Age group 20-60 years
- Weight 50 – 70 kilograms
- Surgeries on forearm and hand

Exclusion Criteria

- Patient refusal
- Local infection at needle insertion site.
- Coagulopathy
- Patient on anticoagulants.
- Pneumothorax or previous pneumonectomy on the opposite side.

All patients were preoperatively evaluated for any systemic diseases and investigations done prior to assessment. Procedure was explained in detail and written consent obtained.

The procedure was carried out in the theatre, where facilities for resuscitation was available.

Equipments:

- Sterile tray
- Sterile towel

- Sterile swabs
- Sponge holding forceps
- Povidone iodine solution
- 20ml syringe.
- 2ml syringe with 24 G needle
- BRAUN- Stimuplex DIG – Nerve locator
- Disposable Braun – Stimuplex (insulated) needle A50 (22G x2")

Drugs

- 0.5% Bupivacaine vial
- Distilled water 2 x10 ml vials
- Clonidine Hydrochloride ampoule -150 µg/ml
- 2% lignocaine vial

Intraoperative and postoperative monitoring parameters :

- Heart rate.
- O2 Saturation.
- Non invasive Blood Pressure
- Electro Cardio Graph.

Initially the preprocedure parameters were recorded i.e., Heart rate, Systolic BP, Diastolic BP, Mean BP SPO2& ECG. These were taken as baseline values before giving the block. Then block was performed. All through the study these parameters were monitored continuously except the NIBP which was recorded intermittently. Postoperatively they were monitored for 24 hours.

Patients were observed vigilantly for the development of various complication.

Subclavian Perivascular Technique:

- Intravenous line was started for all the patients with 18G (green) intravenous Canula after connecting monitors to the patient.
- The patient was positioned on the table and proper illumination was done at the site of block.
- For Continuous neurological evaluation no sedative drugs were administered pre-operatively.

Position:

- Patient placed in supine position with head turned to the side opposite to the side that is to be injected.
- The arms are at the patient's side with the hands pointing towards the knee.
- The arm on the side to be injected may be pulled to depress the clavicle and the shoulder.
- A rolled towel is placed lengthwise between the shoulders along the spine to give the best exposure to the area.

Procedure :

Initially the Nerve locator is set to deliver 0.9 mA current at 2 HZ frequency and 100 μ sec pulse width & its functional status assessed. Positive pole of the cable is connected to the patient's arm on the side of block. Negative pole of the cable is connected to stimulating block needle. Injecting syringe with local anaesthetic solution is connected with extension catheter of the block needle.

In this procedure the desirable evoked motor response (EMR) with needle stimulation is elbow flexion or finger flexion & extension of the hand on block side. Once the evoked motor response is obtained, the set current is decreased gradually to 0.2 – 0.4 mA. Our target is obtaining an EMR at 0.2 – 0.4 mA.

Steps

The area should be aseptically prepared and draped.

- The anaesthesiologist stands at the head end of the table.
- The patient is asked to lift the head slightly to bring the clavicular head of the sternomastoid muscle into prominence.
- The index finger is placed lateral to the muscle and the patient is said to relax. Roll the index finger laterally across the belly of the muscle until the interscalene groove is palpated.
- The finger is then moved inferiorly down the groove until the pulse of the subclavian artery is palpated between the scalene muscles.
- After aseptic preparation, a skin wheal is raised at this point with 2ml of 2% lignocaine with a 24G needle about 2 - 3 cms above the midpoint of the clavicle.
- The pulsation of the subclavian artery against the palpating finger is a guide to supraclavicular block.
- The needle enters at the level of C7 in the interscalene groove.

The stimulating block needle is inserted just above the palpating finger and advanced in a direction, which is directly caudal running parallel to the sagittal axis. The needle should be held between the thumb and index finger, so the hub lies against the skin of the neck during advancement. The needle is advanced behind the palpating finger until an evoked motor response of elbow or hand muscle is obtained at 0.2 – 0.4 mA.Once the desirable evoked motor response of the elbow or hand is obtained at 0.2 – 0.4 mA the needle is stabilized and 2-3ml of local anaesthetic is injected. If the needle is in the perivascular space, the volume of local anaesthetic will produce a “pressure paraesthesia”. The rest of the local anaesthetic should then

be injected in small increments with frequent aspiration to prevent an intravascular injection.

If the needle penetrates the artery, it simply indicates that it is too far anterior.

* The intercostobrachial and medial cutaneous nerves are blocked separately at the axilla anterior to the axillary artery by subcutaneous infiltration of local anaesthetic to ensure complete anaesthesia of the upper extremity.

* The needle should not be advanced beyond 2.5 cm to avoid the risk of complications. (cervical cord injury, pneumothorax, carotid artery puncture).

* A cough by the patient is a warning that the pleura is being irritated by the needle.

After injecting the local anaesthetic, the block is tested for both sensory (using pin prick) and motor (using muscle power) and is compared with the same stimulation or power in the contralateral arm. Motor block was evaluated by thumb abduction (Radial nerve), thumb adduction (Ulnar nerve), thumb opposition (Median nerve) and flexion of the elbow in supination and pronation of the forearm (musculocutaneous).

The Hollmens scale is used in the study for assessing both sensory and motor blockade.

Hollmen's scale

Sensory blockade(Grade)

1. 0 – Normal sensation of pin prick.
2. + - Pin prick felt as sharp pointed but weaker compared with the same area in other extremity.

3. ++ - Pin prick felt as touch with blunt object.
4. +++ - No perception of pin prick.

Onset of blockade means minimum grade 2 and complete blockade means minimum grade 3.

Motor blockade(Grade)

1. 0 – Normal muscle function
2. + - Slight depression in muscle function as compared with pre anaesthetic power.
3. ++ - Very weak muscular action persisting in muscle.
4. +++ - Complete block with absent muscular function.

Onset of blockade means minimum grade 2 and complete blockade means minimum grade 3.

Nerves studied in the block

Sensory

Lateral cutaneous nerve of arm
Medial cutaneous nerve of arm
Medial cutaneous nerve of forearm
Posterior cutaneous nerve of forearm
Lateral cutaneous nerve of forearm
Median nerve
Ulnar nerve
Radial nerve

Motor

Median nerve
Ulnar nerve

Radial nerve

Musculocutaneous nerve

Evaluation was carried for every minute after completion of the injection and the time of onset was noted for both sensory and motor blockade.

Onset of blockade, both sensory and motor is defined as a minimum of grade 2 in Hollmen's scale.

Blockade was considered **complete** when sensory and motor scores were at least grade 3 in Hollmen's scale. Only patients with complete sensory block were included in the study.

Once block was complete, surgery was allowed to proceed.

Duration of sensory blockade was considered as the time interval between the onset of sensory blockade and the onset of paraesthesia (during recovery) while duration of motor block was defined as the time interval between the onset of motor blockade and the recovery of motor block.

Sedation was assessed using the **sedation score** described by **Culebras et al.**[51] where sedation was graded on a scale of 1 to 5 as follows:

1. awake and alert
2. sedated, responding to verbal stimulus
3. sedated, responding to mild physical stimulus
4. sedated, responding to moderate or severe physical stimulus
5. not arousable.

Monitoring :

Monitoring during anaesthesia focuses on systemic effects of Clonidine, local anaesthetic toxicity from excessive tissue absorption (usually 40 – 60 min), ventilation , oxygenation and the consequences of surgical stress such as tourniquet pain or blood loss.

Preprocedure parameters i.e., Heart rate, Systolic BP, Diastolic BP, Mean BP SPO2& ECG were recorded before giving block. These were taken as baseline values. All through the procedure these parameters were monitored continuously except the NIBP which was recorded intermittently. Postoperatively they were monitored for 24 hours.

As systemic absorption of clonidine produces maximum haemodynamic effects within 2 hours[48], these parameters were recorded over the period of 2hours & compared with the baseline values.

Onset, completion of blockade, duration of blockade was assessed as described earlier.

Pain was assessed using a numerical rating pain score scale where 0 represents no pain and 10 means the worst possible pain. (VAS scale – Annexure. 4a)

Statistics & Analysis:

Sample size of 20 per group was adequate for the present study.

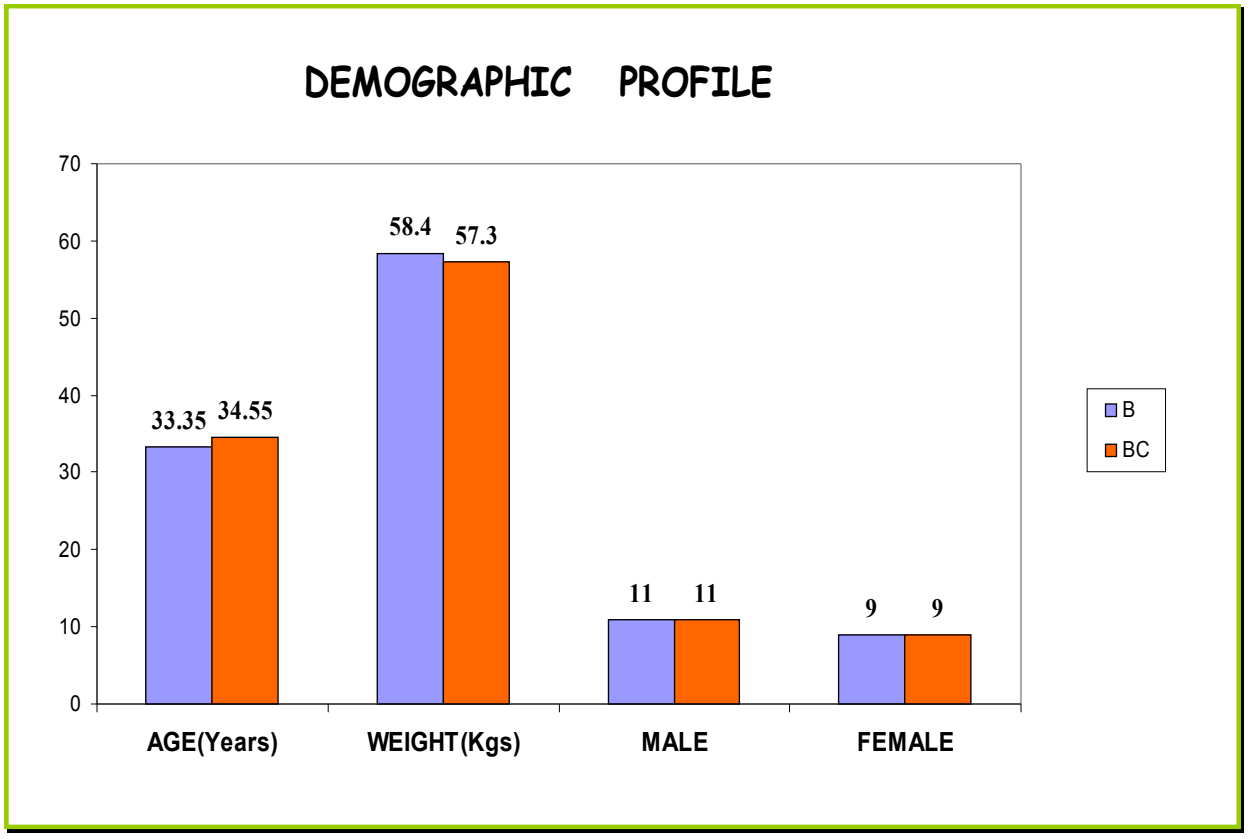
Data like age, weight, onset, completion & duration of blockade were analyzed using students independent t – test.

Data like intensity of blockade, sedation score were analyzed with chi-square test.

Data were expressed as Mean ± SD. P value < 0.05 was taken as statistically significant.

Mean values of haemodynamic parameters (Heart rate, systolic BP, diastolic BP, mean arterial pressure) over the period of 2 hours (at 10 minutes interval) after giving the block were compared with the base line values. Any deviation of more than 30% from the base line values were taken as haemodynamic instability[25,26].

OBSERVATIONS



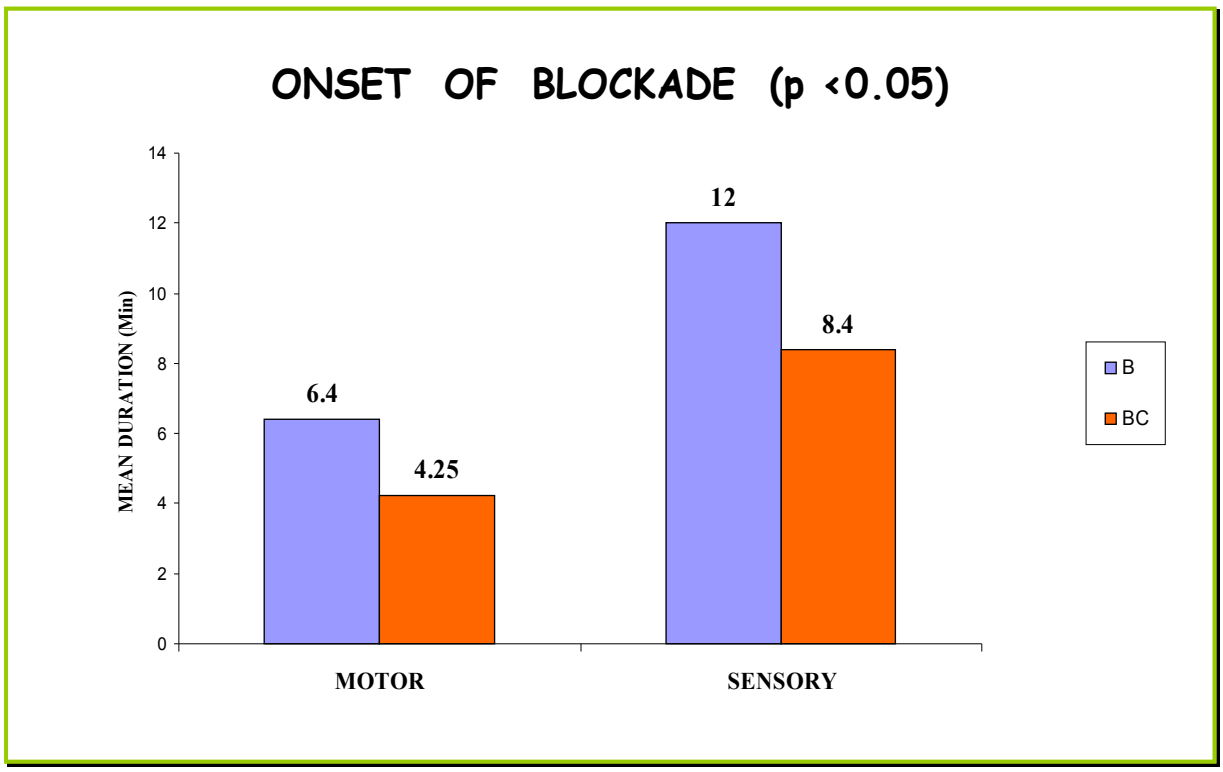
The mean **age** in B group was 33.35 years ± 8.60 SD and in the BC group it was 34.55 years ± 11.56 SD. (t = 0.37 , p = 0.712)

The mean **weight** in B group was 58.40 kgs ±6.15 SD and in the BC group it was 57.30 kgs ± 4.75 SD. (t = 0.63, p = 0.530)

Sex distribution in each group: 11 males and 9 females.

Thus the demographic profile was comparable between the two groups. (p value = NS).

The mean **duration of surgery** was comparable between the two groups: 91 ± 16.03 mins in Group B and 94 ±12.83 mins in Group BC.(t =0.65, p=0.517)



The mean time of onset of **motor** block in

Group B : 6.40 ± 1.14 mins

Group BC : 4.25 ± 0.72 mins

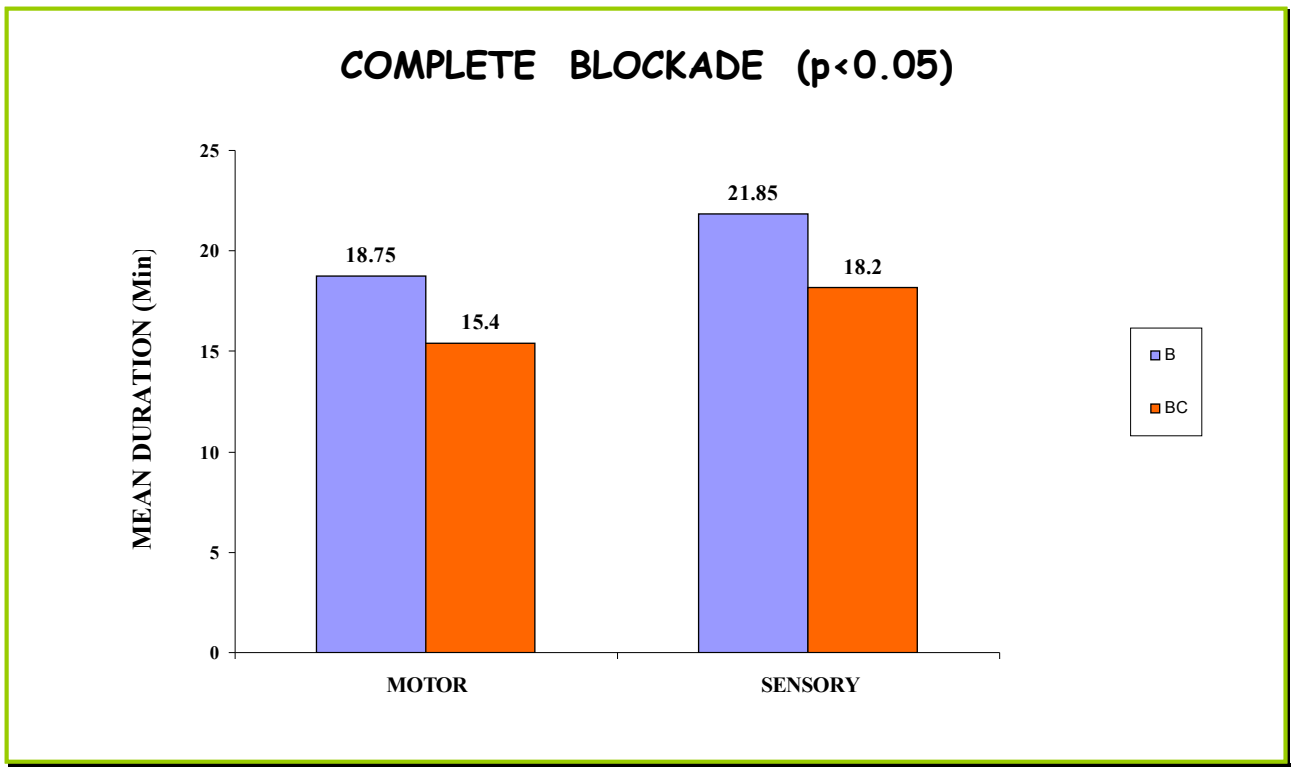
The onset of motor blockade was statistically **significant** in BC group. ($t = 7.13$, $p < 0.05$).

The **onset** time of **sensory** block in

Group B : 12.00 ± 1.97 mins

Group BC : 8.40 ± 0.82 mins

The onset of sensory blockade was statistically **significant** in BC group. ($t = 7.53$, $p < 0.001$). **Motor** blockade occurred **earlier than sensory** blockade in both the groups ($p < 0.05$).



The mean time for **complete motor block** was

Group B : 18.75 ± 2.71 mins

Group BC : 15.40 ± 2.04 mins

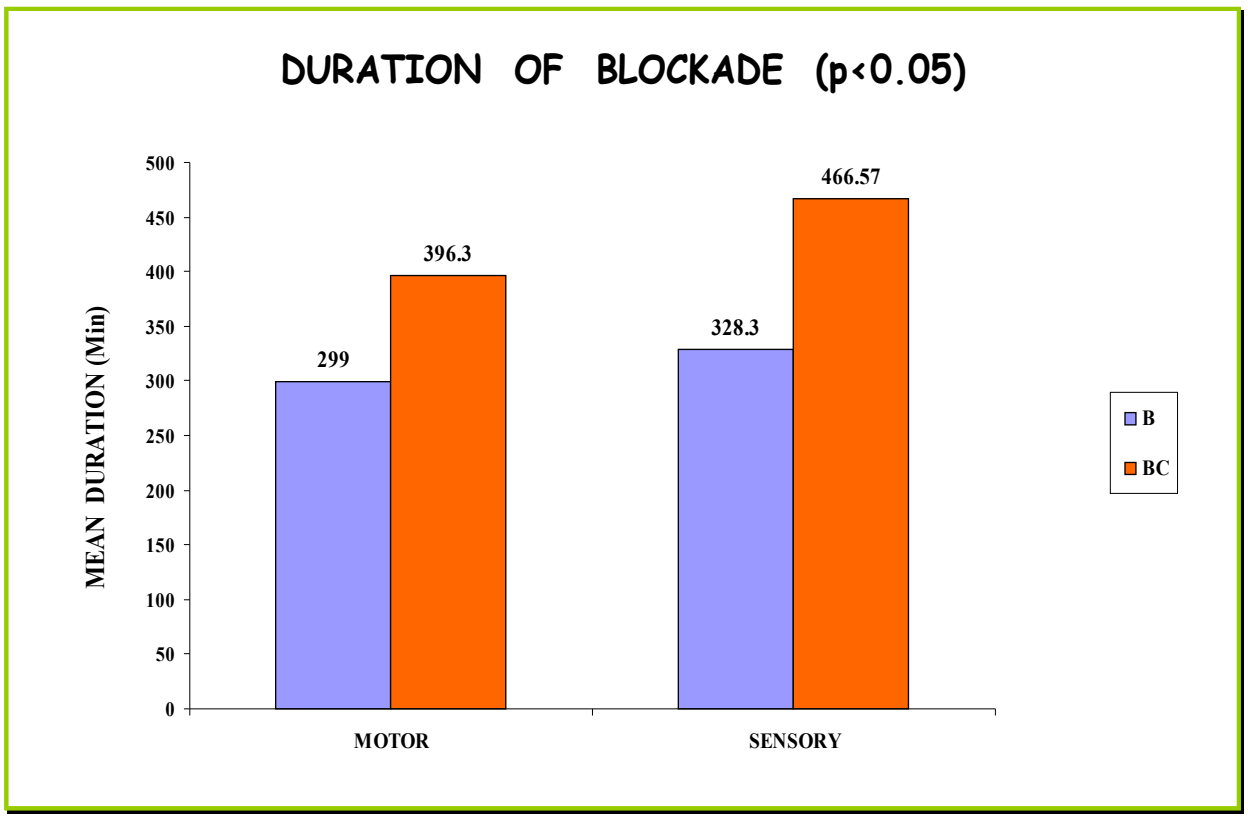
The time for complete motor block was statistically **significant** in BC group. (t = 4.42, p < 0.05).

The mean time for **complete sensory block** was

Group B : 21.85 ± 2.37 mins

Group BC : 18.20 ± 2.14 mins

The time for complete sensory block was statistically **significant** in BC group. (t = 5.11, p < 0.05).



The mean total **duration of motor** blockade was

Group B : 299.00 ± 23.32 mins

Group BC : 396.30 ± 14.92 mins

The mean total duration of motor blockade was statistically **significan**t. (t = 15.72, p < 0.05).

The mean total **duration of sensory** blockade was

Group B : 328.95 ± 34.13 mins

Group BC : 466.75 ± 13.91 mins

The mean total duration of sensory blockade was statistically **significan**t (t = 16.72, p < 0.05).

INTENSITY OF BLOCKADE

	Grading	Group B	Group BC
MOTOR	4	12 (60 %)	15 (75 %)
	3	5 (25 %)	4 (20 %)
	2	2 (10 %)	0
	1	0	1(5%)
SENSORY	4	15 (75 %)	16 (80 %)
	3	5 (25 %)	4 (20 %)
	2	0	0
	1	0	0

Intensity of Motor blockade

Group B - 60% patients had grade 4 motor block while 25% had grade 3 and 10 % patients had grade 2 motor block.

Group BC - 75% patients had grade 4 motor block while 20% patients had grade 3 block and 5%had grade 1 motor block.

This was **not** statistically **significant**. ($X^2 = 3.73$, $p = 0.29$)

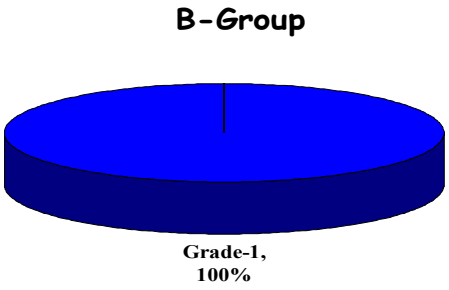
Intensity of Sensory blockade

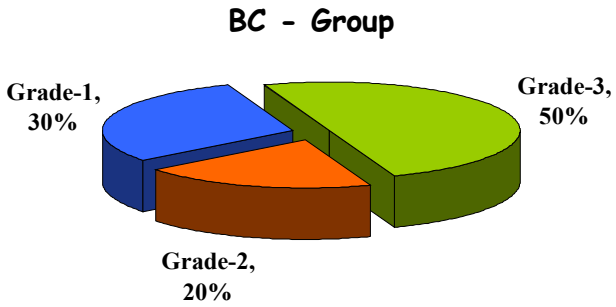
Group B - 75% patients had grade 4 sensory block and 25% patients had grade 3 sensory block.

Group BC - 80% patients had grade 4 sensory block and 20% patients had grade 3 sensory block.

This was **not** statistically **significant**. ($X^2 = 0.143$, $p = 0.704$)

SEDATION





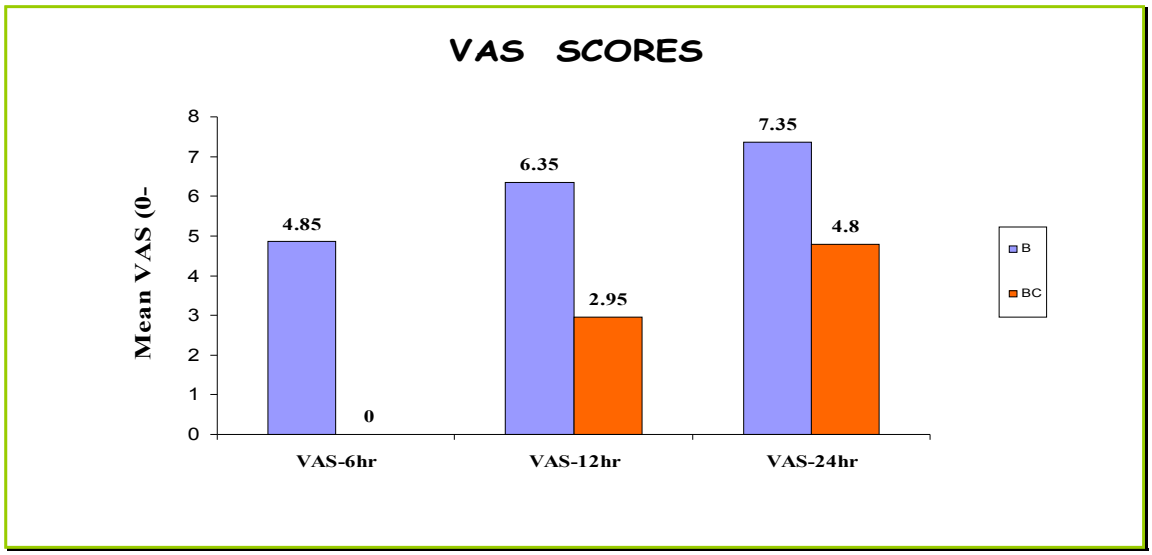
Sedation scores differed between the two groups during the intraoperative period (at 30 min).

Group B : None of the patients was sedated i.e. all were awake and alert

Group BC : 50% patients were sedated and required mild physical stimulus to awaken, 20% patients sedated and required verbal stimulus to awaken and 30% not sedated..

No patient in BC group required assistance for airway maintenance due to sedation.

Sedation score achieved during the intraoperative period was statistically significant ($\chi 2=21.53$, $P<0.001$). Sedation scores did not differ between the groups during the postoperative period.



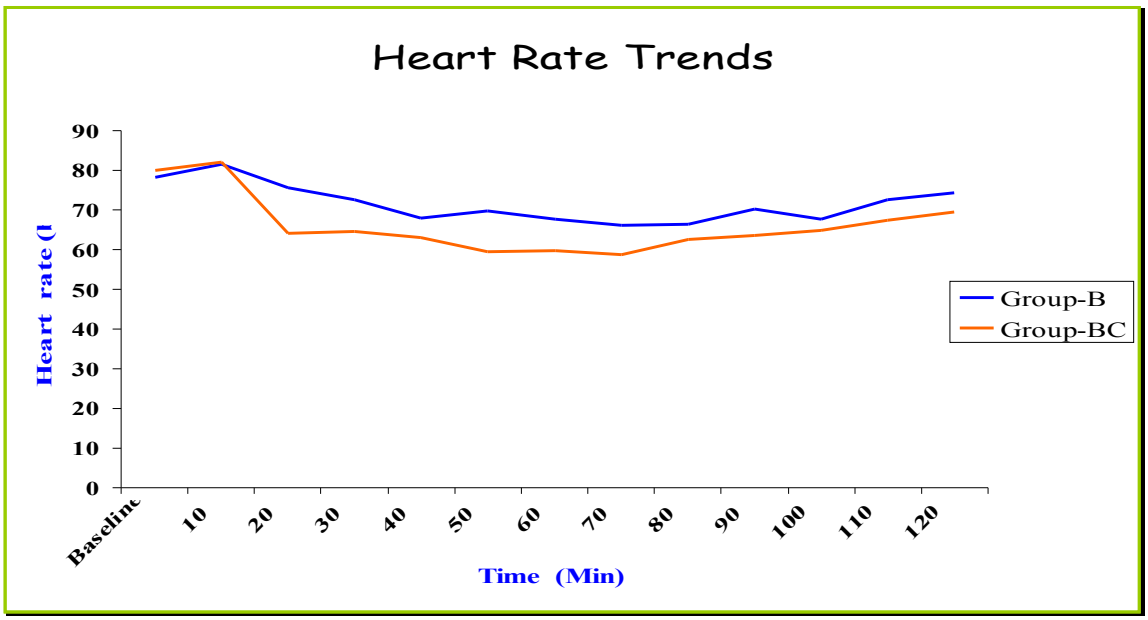
Postoperative pain scores were recorded according to Visual Analog Scale (VAS 0 -10, Annexure 4a) at 6, 12 and 24 hours. Group BC patients recorded a lower mean VAS score than their counterparts. Likewise the rescue analgesic requirement (Inj. Diclofenac sodium 3ml IM) was lower in BC group (4 patients) compared to group B (13 patients). Both were statistically significant ($p < 0.05$).

Haemodynamic Parameters:

The baseline & first 2 hours haemodynamic parameters observed during the study period for both the groups were tabulated as shown in the annexure (2b, 2c, 3b&3c).From these, mean value over the period of 2hrs[48], mean baseline value, deviation from the baseline (+ indicates increase, - indicates decrease) values were derived.

Heart rate **significantly** decreased during the intraoperative period when compared to baseline values in clonidine group. Diastolic BP, systolic BP, mean arterial pressure were lower in clonidine group than control group but **not significant.**

Parameters	Group-B			Group-BC		
	Mean over 2hr	Base Line	Deviation From baseline	Mean over 2hr	Base Line	Deviation From baseline
Heart Rate bpm	71.01 (± 2.27)	78.10 (± 9.65)	-7.03 (± 8.54)	65.00 (± 2.29)	80.00 (± 7.71)	-15.00 (± 7.22)
Systolic BP mmHg	118.8 (± 4.06)	122.30 (± 9.10)	-3.5 (± 6.19)	113.74 (± 2.84)	119.05 (± 7.33)	-5.31 (± 6.80)
Diastolic BP mmHg	77.48 (± 2.68)	77.90 (± 5.75)	-0.42 (± 4.90)	75.03 (± 2.20)	79.75 (± 6.21)	-4.72 (± 4.97)
Mean Arterial Pressure mmHg	91.25 (± 2.88)	92.50 (±6.43)	-1.25 (± 4.78)	87.9 (± 2.47)	92.85 (± 6.13)	-4.95 (± 4.84)



No haemodynamic instability (deviation > 30%) occured in both group during the study period.

COMPLICATIONS

There was one incidence of arterial puncture without formation of hematoma in group-B. Needle was again repositioned, aspirated and drug administered. Block was successful. There was no other incidence of

- Pneumothorax
- Neurological deficit
- Phrenic nerve palsy
- Horner's syndrome
- Excess sedation
- LA toxicity

In one patient (in Clonidine group) heart rate went below 50 during intraoperative period and treated with Inj.Atropine 0.6 mg i.v.

Blood pressure, oxygen saturation and respiration were monitored and were stable.

DISCUSSION

Brachial plexus blockade offers an excellent alternative technique to general anaesthesia in anaesthetising the upper limb for surgical procedures. Various approaches for successful performance of these blocks and for reducing the complications have been described.

The ***technique*** chosen in this study was the Nerve locator assisted subclavian perivascular technique. In 1964 subclavian perivascular technique was described by Winnie[1] and it allowed accurate percutaneous localisation of the plexus. He used the concept that there is a constant relationship between the anterior and middle scalene muscles, the plexus and the first rib and that there is an advantage of the continuity of the neurovascular sheath of the brachial plexus. Winnie's concept that the roots of the plexus were sandwiched between the two scalene muscles and the muscles are always found to be inserted in the 1st rib. Hence he introduced the needle between the two muscles and in the direction of the space between them. Thus by using a single needle technique eliciting paraesthesia or vascular pulsation as a guide to confirm the needle placement in the space he injected the anaesthetic solution, which will be confined to the perineural and perivascular area. Hence he was almost certain of a complete and safe block. This technique by Winnie was anatomically precise and conceptually logical.

Elicitation of paraesthesia to confirm the needle position in nerve blocks are now becoming less popular as it has problems in the form of direct neuronal damage by the advancing needle, patient discomfort and failure rates. While using nerve locator as an aid to the nerve blocks, these problems can be avoided.Various studies demonstrated its effective usefulness in peripheral nerve blocks [8,9,10,11,12].

Bupivacaine hydrochloride was the first local anaesthetic that combined the properties of an acceptable onset, long duration of action and profound conduction blockade.

Various agents like epinephrine, opioids, Ketamine, potassium chloride, verapamil neostigmine, hyaluronidase and Sodium bicarbonate have been used as ***adjuvants*** to local anaesthetics in brachial plexus block to quicken the onset, increase the duration and enhance the quality of block and also to reduce the post operative analgesic requirements. The results have been mixed and at times associated with side effects.

Clonidine as an additive to local anaesthetics has been studied in the intrathecal, epidural & caudal routes [4,5,6,7,]. It has been proved in these studies hat clonidine is as useful additive by way of improved analgesia and with sedation.

Even though clonidine used as an adjuvant in wide range of doses (30-300µgs) with local anaesthetics to demonstrate its effects in various studies, Bernard et al[41] in their study clearly concluded that the best dose to use clinically is 60-100µg to limit the α2 agonist side effects. Hence 100µg dose was chosen in this study.

In this prospective randomised comparative study, 40 patients satisfying the selection criteria underwent brachial plexus block with or without addition of clonidine. Comparison of onset, completion, duration & intensity of blockade, sedation, haemodynamic changes and quality of analgesia between the two groups were observed and statistically analysed.

The ***onset*** of sensory and motor blockade was quicker in the clonidine group. This

could be due to the synergistic action of clonidine with that of local anaesthetics.

The onset of motor block was found to be faster than the sensory block. This may be attributed to the arrangement of nerve fibres in the trunks as described by Winnie[40]. Motor fibres are located more peripherally than sensory fibres. Hence a local anaesthetic drug will begin to block motor fibers before it arrives at the centrally located sensory fibres.

Duration of sensory block tended to last longer than motor block in the present study. This is in line with the observations made by de Jong et al[33] who explained that larger fibres require a higher concentration of local anaesthetic than smaller fibres. The minimal effective concentration of local anaesthetic for large (motor) fibers is greater than for small (sensory) fibers. Thus, motor function return before pain perception and duration of motor block is shorter than the sensory block.

Time taken to complete the motor&sensory blockade was significantly lesser in Clonidine group.

In this study, during postoperative period ***pain scores*** were significantly lower in patients who received clonidine in addition to Bupivacaine. The number of patients who required rescue analgesia was also lower in this group.

As an α2-specific adrenergic agonist, it has been presumed that the block-prolonging effect of clonidine results from a pharmacodynamically mediated mechanism. Clonidine blocks the conduction of C and A gamma fibres and increases potassium conductance in isolated neurons and intensifies conduction block of local anaesthetics. However, the data supporting this assumption is conflicting. For example, consistent with the presumption that clonidine

exerts its effects pharmacodynamically, several studies have shown that peak plasma concentrations of local anaesthetics are unaltered when clonidine is added.[50,54] However, data from other studies have shown that clonidine does decrease peak local anaesthetic plasma concentrations to the same extent as epinephrine, a fact that supports a pharmacokinetic mechanism.[18,52,53] Other evidence of a pharmacokinetic mechanism comes from studies showing that clonidine itself (as a sole agent)is incapable of producing nerve block in the absence of coadministered local anaesthetics. [49]

Sedation scores were higher in patients in clonidine group compared to control group during the intraoperative period. Even though sedation is one of the side effects of clonidine, it is a desirable one for the surgical procedure during intraoperative period. No patient experienced airway compromise or required airway assistance due to this sedation. ***Heart rate*** in clonidine group was significantly decreased during the intraoperative period. Both these effects could be due to partial vascular uptake of the drug and its transport to the central nervous system where it acts[48]. At the same time no haemodynamic instability was observed in both the groups.

No complications with regard to the technique or drug was observed except accidental arterial puncture in one and decrease in heart rate (<50) in one of the cases.

SUMMARY

1. Onset time for both motor and sensory block was quicker in the Bupivacaine with clonidine group.
2. Time taken for completion of both motor and sensory blockade was significantly lesser in clonidine group.
3. There was no difference between the groups in the intensity of blockade.
4. The mean duration of both sensory & motor blockade was significantly prolonged in clonidine group.
5. Sedation was statistically significant with Bupivacaine-clonidine group in the intraoperative period.
6. Heart rate significantly decreased in clonidine group during intraoperative period.
7. There was no haemodynamic instability in both the groups in the study period.
8. There was no complication due to the addition of 100µg clonidine to Bupivacaine.

CONCLUSION

In conclusion, clonidine 100µg (in 2ml)when used as an additive to 0.375% Bupivacaine(30ml) solution for Supraclavicular brachial plexus block, quickens the onset of sensory & motor blockade and prolongs the duration of sensory & motor blockade. It also improves the quality of post operative analgesia with mild intraoperative sedation and decreases the heart rate without any haemodynamic instability. Hence, clonidine can be considered as a safe additive to local anaesthetic solution for brachial plexus blocks.

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1. PROFORMA

Name: Patient ID: Age/Sex: Wt: ASA Status:

IP No: Surgery: Duration of Surgery: Group : B / BC

Onset of block - Motor : Sensory :

Completion of block - Motor : Sensory :

Intensity of block - Motor : Sensory :

Duration of block - Motor : Sensory :

Sedation Score: Complication :

		0 min	5 min	10 min	15 min	20 min	30 min	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	12 hr	24 hr
Spo2															
Respiratory Rate															
Sens & Motor Score															
Radial Nerve	S														
	M														
Median Nerve	S														
	M														
Ulnar Nerve	S														
	M														
Musculocut. Nerve	S														
	M														
Sensory Score															
Lat Cut N of arm															
Medial Cut N of arm															
Lat Cut N of forearm															
Med Cut N of forearm															

Haemodynamic Parameters.

	Heart Rate-bpm	Systolic BP-mmHg	Diastolic BP-mmHg	Mean Arterial BP-mmHg
Base line				
10 Min				
20 Min				
30 Min				
40 Min				
50 Min				
60 Min				
70 Min				
80 Min				
90 Min				
100 Min				
110 Min				
120 Min				
2 ½ Hr				
3 Hr				
3 ½ Hr				

VAS Score	
At 6 hr	
12 hr	
24 hr	

4 Hr				
5 Hr				
6 Hr				
12 Hr				
24 Hr				